Museum, Dr. Broom contributes an illustrated article on the dinosaurs of the Stormberg beds. Seven generic types, namely, Euskelesaurus, Hortalotarsus, Gyposaurus, Gryponyx, Massospondylus, Ætonyx, and Geranosaurus, are recognised, of which the third, fourth, sixth, and seventh are described for the first time. The first six are referable to the carnivorous group, but the last is characterised by the presence of a predentary bone to the mandible. This feature suggests that the horizon of the Stormberg beds from which it was obtained is of Lower Jurassic, in place of Triassic, age; and, even so, Geranosaurus will be the oldest known type with a predentary.

The angulated outer and rounded inner surface of the terminal segment of the second hind toe in Gryponyx, Massospondylus, and Ætonyx indicates that the investing horny claw had an edge adapted for combing or scraping; and it is suggested that it was employed for cleaning the skin and scales. If this be so, the dermal covering was probably unlike that of crocodiles or lizards; and it may be that the scales were long and narrow with intervals of soft bare skin between them. Such a skin would certainly require cleansing with the claw after the reptiles had been hunting on the muddy banks of lakes.

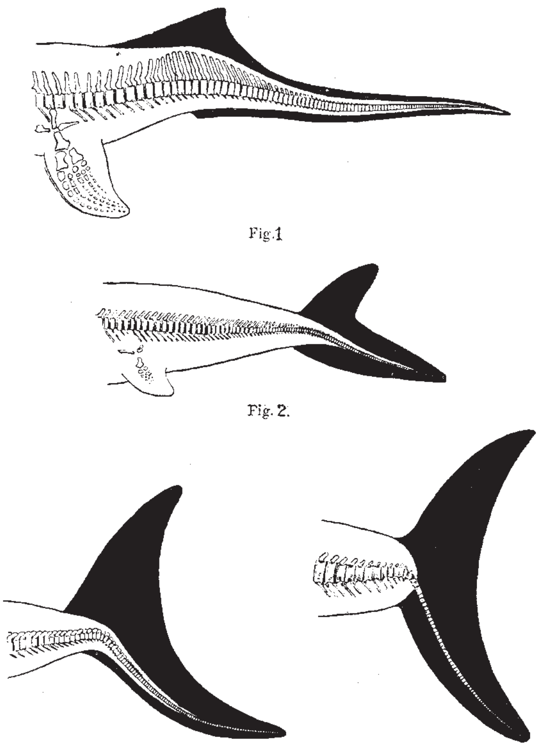
Fig. 1
Fig. 2
Fig. 3. Fig. 4.

Tail-fins of Ichthyosauria.

FIG. 1.—*Mixosaurus nordenskjoeldi.*
FIG. 2.—*Ichthyosaurus quadriscissus* (young).
FIG. 3.—*Ichthyosaurus quadriscissus* (adult).
FIG. 4.—*Ichthyosaurus trigonus posthumus.*

In the same issue Dr. C. W. Andrews describes portions of the skeleton of a plesiosaur (*Plesiosaurus capensis*) from the Uitenhage beds of Cape Colony. The species, which belongs to the group of small forms represented in the European Wealden by *P. degenhardti* and *P. valdensis*, is the first plesiosaur known from South Africa. The occurrence of a member of the group in that country is of special interest, in view of the possibility that the Sauropterygia may have taken origin from a form related to the therocephalous anomodonts of the South African Permian.

In this connection reference may be made to the identification by Mr. H. Fuchs (*Anat. Auz.*, vol. xxxviii.) of a septomaxillary bone in the skull of the peba armadillo. In a review of this discovery by Mr. F. Müller in *Naturwissenschaftliche Wochenschrift* for July 9, 1911, it is pointed out that a septomaxillary has been hitherto known in amphibians and certain reptiles, in which it forms an ossicle on the side of the nasal capsule. Recently it has been identified in certain fossil reptiles—notably the Theriocephala and Theriodontia. Among mammals, it occurs not only in the peba, but likewise in the hairy armadillo (*Dasypus villosus*), where it is represented by an undetermined bone described by Dr. Broom. It has not yet been definitely identified as a separate ossification in other mammals; but Gaup considers that it is represented by the so-called extra nasal process of the maxilla, although Fuchs considers that in the aforesaid armadillo both this process and the septomaxillary are present. Be this as it may, the identification in armadillos of an element common to amphibians, anomodonts, and certain other reptiles is a feature of prime importance in regard to the anomodont ancestry of mammals.

The description of an embryonic, or newly born, specimen of *Ichthyosaurus quadriscissus* from the Lias of Holzmaden, Württemberg, in which the outline of the body and fins is preserved, has led Dr. E. Fraas, in *Mitt. aus dem kgl. Naturalienkabinett, Stuttgart*, to give an interesting account of the evolution of the tail-fin in the ichthyosaurs. That the specimen on which the investigation was based is extremely young is rendered evident by the great relative size of the head, which is equal to one-third the entire length, whereas in the adult it is less than one-fifth. The earliest known type of tail-fin in the ichthyosaurs occurs in *Mixosaurus nordenskjoeldi* from the Muschelkalk of Spitsbergen, in which, according to Mr. H. Wiman's figure in Bull. Geol. Inst. Upsala, vol. x., 1910, it takes the form of a low falcate fin in the basal third of the tail, continued as a marginal expansion along the whole of the rest of the tail, both above and below. In the young of *I. quadriscissus* the falcate portion and the marginal fringe are increased in height so as to form a fin approximating to the heterocercal type, with the extremity of the vertebral column bent down into the lower lobe. In the adult of the same species the increase in the size of the fin and the degree of flexure of the vertebral column are intensified, thus producing an approximation to the homocercal type. A further stage is displayed by *I. trigonus posthumus*, of the Upper Jurassic Limestone of Solenhofen, in which the fin is almost completely like that of a homocercal fish, while the flexed terminal portion of the vertebral column has diminished in relative size, with a marked increase of the angle of flexure. One step more and it would have vanished. A somewhat similar grade is presented by Opthalmosaurus of the Oxford and Kimeridge Clays. It should be added that in the hind paddle of Mixosaurus the metatarsal and phalangeal bones retain an elongated contour, and do not form a mosaic-like structure.

R. L.

LONG-DISTANCE RADIO-TELEGRAPHY.

A VERY interesting paper by Mr. L. W. Austin, entitled "Some Quantitative Experiments in Long-distance Radio-telegraphy," has recently been published in the Bulletin of the Bureau of Standards (Reprint No. 159). The paper describes a complete investigation of the relationship between the current in the receiving aërial and the distance between the transmitter and receiver, the observations being mainly by the shunted telephone method. Although this method is not so accurate as the direct method, it is probably the only one available for use on board ship at long distances. Some years ago Mr. J. E. Taylor and the present writer carried out similar experiments over short distances up to 60 miles, using a thermo-galvanometer directly in the aërial. Mr. Austin has greatly extended the range, and has carried on the experiments up to a distance of 1200 miles between the two stations. The results confirm the proposition put forward by Mr. Taylor and the writer that the current in the receiving aërial varies inversely with the distance except for one important particular, namely, Mr. Austin finds, with much longer distances that he has worked

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over, that it is necessary to take into account the absorption, and therefore his formula contains an exponential term to allow for this.

A perhaps still more important discovery mentioned in the paper is that of Dr. Louis Cohen, that if the reduction in the strength of the received current due to absorption be written e^{-Ad}, then A is inversely proportional to the square root of the wave-length within the limits of accuracy of the experiments.

Mr. Austin again checks Mr. Marconi's statement that the received signals are proportional to the height of the two antennæ, and adding to this the observation that they also vary inversely as the wave-length, he obtains a complete formula giving the received current I_R in terms of the transmitted current I_S, the heights of the two antennæ $h_1 h_2$, the wave-length λ, and the distance d. The formula is

$$I_R = 4{\cdot}25 \frac{I_S h_1 h_2}{\lambda d} e^{-\frac{0{\cdot}0015 d}{\sqrt{\lambda}}}.$$

Where the currents are in amperes and the lengths in kilometres, the two constants 4·25 and 0·0015 may depend on the conditions under which the experiments were made, and it will be of great interest if other wireless workers will check the formula against their results and see how closely it is applicable. It must not be expected that this formula will be closely confirmed by every observation. Mr. Austin's own observations show that this is not the case. In spite of the wide range of values he has dealt with, the observations do appear to group themselves round the smooth curves given by his formula.

The formula refers only to flat-topped aërials and to general day conditions. Mr. Austin remarks that the night signals are entirely irregular, being, in general, stronger than the day signals, and this he assumes is due to there being much less absorption at night, that is to say, the inverse distance law is then more nearly obeyed, even for very long distances.

It is perhaps of interest to compare Mr. Austin's formula with the measurements in the *Monarch* tests. Putting the data into Mr. Austin's formula, and taking the wave-length at 250 metres, which was approximately the case, the received current at a distance of 60 miles given by the formula is 590 microamperes, whereas it was actually only about 50 microamperes. It is evident, therefore, that the constant 4·25 is too large for this case. One reason for this may be the great difference in the type of aërial used, Mr. Austin's formula applying to a flat-topped aërial, whereas a straight aërial was used for the Holyhead-Howth experiments; another reason, the Howth aërial had a higher resistance.

The absorption coefficient, however, seems to fall in very well with the *Monarch* experiments, neglecting the short distances, which are irregular. Taking the slope of the curves for the *Monarch* crossing from Howth to Holyhead, the absorption is rather less than that given by Mr. Austin, but the slope of the curve for the *Monarch* returning from Holyhead to Howth indicates a slightly greater absorption.

A number of tables are given in the paper to facilitate the use of the formula in practice. These tables show how extremely important it is to use a long wave-length for long distances; for instance, for transmission over a distance of 2000 miles, with a wave-length of 1000 metres and two flat-topped aërials 450 feet high, 490 amperes is required in the transmitter, whereas at 6000 metres only 105 amperes is necessary. There are still, however, many obscure points in the long-distance transmission which Mr. Austin's formula does not account for; for instance, Mr. Marconi pointed out at the Royal Institution a short time back that there were two minima near sunset and sunrise in the curve representing the strength of the received signals across the Atlantic, and also two maxima. Can this be accounted for purely by variation in the absorption coefficient, and, if so, does the absorption coefficient during the minima bear the same relationship to the wave-length as that given in Mr. Austin's formula? Do the two maxima correspond to practically no absorption, or are they higher values than would be obtained if no absorption existed as if waves were concentrated, as Mr. Austin seems to consider possible?

Whether the formula turns out to be strictly right or not, it should form a good basis on which to compare different wireless systems, and it constitutes a real advance in the published knowledge of long-distance radiotelegraphy.

W. DUDDELL.

EXPERIMENTS ON AERIAL PROPELLERS.[1]

AN article in the April *Bulletin de la Société d'Encouragement* deals with some experiments on aërial propellers made by MM. Legrand and Gaudart, with the aid of a grant from the society. The greater part of the article is a discussion on the methods adopted by other experimenters for expressing their results. M. Legrand objects to the three coefficients usually adopted in expressing the results of propeller experiments, namely, "pitch," "fraction of pitch in each blade," and "percentage slip." He objects to the use of "constructional pitch" (which is usually taken as the pitch of the pressure face chords), as it is not constant for all parts of the blade in modern propellers. He also objects to the use of the pitch corresponding to no thrust, as this is not constant for all speeds; but in our opinion this latter is constant enough for all practical purposes.

M. Legrand's objection to the use of the coefficient "fraction of pitch in each blade" is that it is not definite for a given propeller; as, in modern propellers, it is not the same for all co-axial, cylindrical sections of the blades. This objection, however, is entirely overcome by using "disc area ratio," which is equivalent to "fraction of pitch," and is also absolutely definite for any given propeller. The objection advanced against the use of "percentage slip" is that the pitch not being definite, or the same for all parts of the blade, the slip is also indefinite.

Efficiency curves by Géber and Dorand are quoted, in which efficiencies at constant rotational speeds are plotted against translational speed. If, however, efficiencies at constant rotational speeds are plotted against percentage slip, and the pitch used in the reduction of the experimental results be stated—the percentage slip being equal to $100\left(\frac{\text{pitch} \times \text{revs.} - \text{translational speed}}{\text{pitch} \times \text{revs.}}\right)$—it is readily seen that the two sets of curves are equivalent and derivable from each other. Also, plotting against percentage slip has the advantage that it brings all the efficiency curves close together.

It is generally admitted that the indefiniteness of the pitch of a propeller is a disadvantage; but it seems, as yet, to be the best "coefficient" that can be used to give a general idea of the type of a given propeller. M. Legrand does not give any substitute for "pitch," and, in connection with his own experiments, differentiates between a propeller with a big pitch and one with a small pitch.

The experiments were carried out on full-size propellers, mounted on actual aëroplanes and driven by a 50 h.p. Gnome engine. The thrust was registered during the whole flight on an autographic diagram from a Richards dynamometer, working in conjunction with a flexible mounting for the propeller. An error is admitted of at least 2 per cent. of the maximum thrust in the calibration of the dynamometer. The rotational speed of the propeller was measured by means of a direct reading tachometer, and is probably correct to about 1 per cent. But the power absorbed was measured by assuming that the brake h.p. of the Gnome engine, at a given speed, did not vary during the course of a series of experiments. By this method of measuring, we should estimate the probable error on the measurement of power to be anything up to 10 per cent. The speed of translation of the machine was measured by means of an ordinary U tube, measuring the air pressure in a converging cone. This was calibrated by flying round a measured aërodrome, taking the speed with a watch. So that, taking into account the difficulty of flying exactly over the course and of reading a water-gauge on a vibrating aëroplane, the translational speed is probably not correct to closer than 3 per cent.

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[1] "Études expérimentales sur les hélices propulsives Aériennes." By M. Legrand (Bulletin de la Société d'Encouragement pour l'Industrie Nationale, April).

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